Supplementary Data2 Forced Guessing Paradigm + Informed Participants (#19979)

Author(s)

Moshe Shay Ben-Haim (Yale University, Hebrew University) - shay.mbh@gmail.com

Laurie Santos (Yale University) - laurie.santos@yale.edu

Ran Hassin (Hebrew University of Jerusalem) - ran.hassin@huji.ac.il

Steve Chang (Yale University) - steve.chang@yale.edu

Yarrow Dunham (Yale University) - yarrow.dunham@yale.edu

1) Have any data been collected for this study already?
No, no data have been collected for this study yet.

2) What's the main question being asked or hypothesis being tested in this study?
We examine a dissociation between conscious and non-conscious processing in human adults. Adults performance in this experiment will be compared to performance of non-human animals (e.g., dogs and monkeys) and human Children in other experiments. We predict that human adults will show conscious and non-conscious dissociations in their performance. Specifically, we predict that participants in the conscious incongruent condition will mostly be above chance and have a positive learning slope, while participants in the non-conscious incongruent condition will mostly be bellow chance and have a learning slope close to zero or will only be slowly increasing. We anticipate that most participants in the non-conscious condition will not learn to perform the task effectively within the duration of the task, unless if participants will become aware of the subliminal cue locations as attested by their self-reports. Yet we anticipate this situation will be rare. We predict that most participants will show the predicted opposite performance dissociation, but differences in size of this dissociation may exist in the different modalities tested, and with the different non-conscious intervals used. In a separate condition, we also wish to compare the performance of participants that preformed in a non-conscious condition, but were tipped halfway through the task about the presence of the cues. We anticipate that this will increase the fraction of participants that become aware of the cues, and consequently able to perform the task very effectively with accuracies way over chance. This will indicate that awareness, rather than cue interval, is the critical part required to learn the task effectively. We also anticipate that a participant in the non-conscious condition that became aware of the cues will have a steep learning slope rather than a slowly increasing gradual learning slope.

3) Describe the key dependent variable(s) specifying how they will be measured.
The dependent variable will be choice accuracy. Participants will be presented with two treasure chests on the left/right sides of the screen, and only one of which has a hidden reward. Participants must guess which side has the reward, and the percent of correct responses will be measured. In addition, we will also estimate the slopes of learning in choice accuracy. We anticipate that in the non-conscious condition the learning slope will not be significantly different from zero or will only be slowly increasing, while in the conscious condition we anticipate that the slop will be steep positive. Similarly, we anticipate that participants in the non-conscious condition who become aware of the cues will have a steep learning curve.
In the awareness objective test, participants will be instructed to directly identify from which of the sides the subliminal cue first emerged, and again we will measure participants' accuracy as representing awareness to the cues location. Participants will also be asked at the end of the experiment if they have used any strategy to complete the task, and we will count the number of participants reporting to strategically go to the opposite of the cue in the non-conscious incongruent condition and the conscious incongruent condition.

4) How many and which conditions will participants be assigned to?
We will test participants in the following conditions
Conscious congruent --> Non-conscious incongruent --> Conscious congruent --> Conscious INcongruent --> objective awareness tests. The order of the incongruent critical blocks (conscious or non-conscious) will be counterbalanced between participants. We will test this in two modalities between participants (key-press or with eye tracking), and with two different non-conscious intervals (first 17ms then 33ms) within participants. In addition, in a separate experimental condition, a separate group of participants in the non-conscious condition will be tipped before the beginning of the 33ms blocks about the presence of the cues and their performance will be compared to the group that was not tipped. This group will only be tested in the order that started in the non-conscious condition.
We anticipate that order may have an effect on performance, such that non-conscious effects will be larger (or even present only) in the order which started with in non-conscious, rather than the order which started with multiple conscious incongruent trials.

5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.
(a) We will analyze performance accuracy deviation from chance (50%) using a one sample t-test as well as a test of the intercept in mixed models (a mixed logistic model with a random intercept for each participant). In addition in mixed models we will also test the possible effects of gender, and trial order, though we consider these tests exploratory. This will be performed separately in each condition (yet in the awareness test we anticipate results not to deviate from chance).
(b) Using actual continuous measure accuracies can be susceptible for a bias if any participant will become aware of the non-conscious cues since conscious strategic performance is expected to be high e.g. ~80-90% while the non-conscious below random effect is hypothesized to be smaller e.g., ~40%. Given this bias, we will also perform categorical tests of participant scores. Specifically, we will compare the ratio of participants with higher than 50% accuracy

and below between conscious and non-conscious conditions compared to expected with a chi square test.

(c) Results allowing, we will perform the proportion comparisons above separately for the conscious and non-conscious incongruent conditions.

For a higher resolution of participant scores, we will compare expected participant distribution of performance scores in the two extreme quadrants expected to include about ~25% of participants as predicted by a binomial distribution of participants performing at random 50%. For example, with 385 trials 24% of participants are expected to obtain an accuracy score at or below 48% by chance (or at or above 52%). We will test if a higher proportion of participants then expected in the non-conscious condition score at or below 48%, and if a higher proportion of participants in the conscious condition score at or above 52%.

(d) Results allowing, we will perform a higher confidence analysis and compare the expected proportion of participants scoring in the most extreme <10% of a random distribution, with scores considered to be significant or marginally significant at the individual participant level. For example, with 385 trials scores at or below 46% are very rare and are expected to emerge by chance in only <10% of participants. We will test if higher proportion of participants in the non-conscious condition score as extreme, or the equivalent >54% in the conscious condition.

(e) We will compare the ratio of participants orally reporting to have used a strategy to go to the opposite location of the cue.

(f) we will estimate and compare the learning slopes in the different conditions.

In the non-conscious condition since different participants are expected to be affected differently by the two intervals, we will analyze the blocks of 17ms and 33ms collapsed together as our main analysis, but also separately for each interval.

6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.

(a) Participants will be excluded if they fail to perform at or above 65% in the first conscious congruent condition.

(b) Participants will be excluded if they fail to complete at least half of the non-conscious trials.

(c) Specific trials will be excluded if the participant made a response longer or shorter than 3 standard deviations in reaction time.

(d) Participants who will report to have used a strategy to go to the opposite of the cue in the non-conscious condition (which is supposed to be invisible/non-conscious) will be excluded. This is relevant to the non-tipped participants groups.

(e) Participants non-conscious condition data in the relevant interval will be excluded if they score 61% or more in the objective awareness test to the non-conscious cues. This is relevant to the non-tipped participants groups.

7) How many observations will be collected or what will determine sample size? No need to justify decision, but be precise about exactly how the number will be determined.

We are willing to test up to 72 participants. However, because this might represent an unnecessarily expenditure of resources, we will use a sequential testing design . Thus, we will test a minimum of 36 participants (12 starting in non-conscious, 12 starting in conscious, and another 12 starting in non-conscious but who will be tipped about the presence of the cues in the middle). Participants will be tested in one modality either keypress or with the eye tracker. Assignment to the response modality will be based on availability of the eye tracker and on the successful calibration of the device to the participant. Once this minimum number of participants has been obtained we will test for our effect using a p-value corrected for sequential testing in 3 time points calculated via the GroupSeq package in R based with Hwang-Shih-DeCani family correction with a phi of 1; for example, if we test the minimum of 12 + 12 +12 participants across all or in each response modality at the first time point this will require p < .0311 to confirm our hypothesis and stop testing. If we do not reach this alpha we can continue for time point t2 with 75% of our maximum participants -- 18 participants in the order/condition required (or 56 if run in all) with the specified corrected alpha of t2 <.0229. or finally if required we will test at the last time point t3 with our maximum set number of participants - 24 in one of the orders/conditions or 72 if run in all with a corrected alpha of p < .0218. Thus for each order/condition and across all conditions we will have 3 time point windows to test our effect with the aforementioned penalized alphas (1st with 50% of max participants; 2nd with 75% of max participants; and last 100% of max participants). Thus we may result in an uneven number of participants in each order/condition in case the effect was not-significant in the 1st or 2nd time points. For the overall effect collapsed across orders, if the effect is not significant in the 1st time point, we may choose to continue running the remaining participants with the order/condition that worked best on participants, as we do anticipate that the effect may be lower/absent in the order that started in the conscious incongruent condition.

1. Lakens D (2014) Performing high-powered studies efficiently with sequential analyses. European Journal of Social Psychology 44, 701–710. DOI: 10.1002/ejsp.2023

8) Anything else you would like to pre-register? (e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?)
Nothing else to pre-register.